Postel

Network Working Group
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Management Information Base for Network Management of TCP/IP-based internets

Table of Contents

1. Status of this Memo 1
2. IAB POLICY STATEMENT 2
3. Introduction 2
4. Objects 5
4.1 Object Groups 5
4.2 Format of Definitions 6
5. Object Definitions 7
5.1 The System Group 8
5.2 The Interfaces Group 10
5.2.1 The Interfaces Table 10
5.3 The Address Translation Group 22
5.4 The IP Group 25
5.4.1 The IP Address Table 33
5.4.2 The IP Routing Table 35
5.5 The ICMP Group 42
5.6 The TCP Group 52
5.7 The UDP Group 61
5.8 The EGP Group 63
5.8.1 The EGP Neighbor Table 64
6. Definitions 67
7. Acknowledgements 88
8. References 89

1. Status of this Memo

This memo provides the initial version of the Management Information Base (MIB) for use with network management protocols in TCP/IP-based internets in the short-term. In particular, together with its companion memos which describe the structure of management information along with the initial network management protocol, these documents provide a simple, workable architecture and system for managing TCP/IP-based internets and in particular the Internet.

This memo specifies a draft standard for the Internet community. TCP/IP implementations in the Internet which are network manageable are expected to adopt and implement this specification.

Distribution of this memo is unlimited.

2. IAB POLICY STATEMENT

This MIB specification is the first edition of an evolving document defining variables needed for monitoring and control of various components of the Internet. Not all groups of defined variables are mandatory for all Internet components.

For example, the EGP group is mandatory for gateways using EGP but not for hosts which should not be running EGP. Similarly, the TCP group is mandatory for hosts running TCP but not for gateways which aren't running it. What IS mandatory, however, is that all variables of a group be supported if any element of the group is supported.

It is expected that additional MIB groups and variables will be defined over time to accommodate the monitoring and control needs of new or changing components of the Internet. The MIB working group will continue to refine this specification and projects a revision incorporating new requirements in early 1989.

3. Introduction

As reported in RFC 1052, IAB Recommendations for the Development of Internet Network Management Standards [1], the Internet Activities Board has directed the Internet Engineering Task Force (IETF) to create two new working groups in the area of network management. One group is charged with the further specification and definition of elements to be included in the Management Information Base. The other is charged with defining the modifications to the Simple Network Management Protocol (SNMP) to accommodate the short-term needs of the network vendor and operator communities. The long-term needs of the Internet community are to be met using the ISO CMIS/CMIP [2,3] framework as a basis. An existing IETF working group, the "NETMAN" group, is already engaged in defining the use of CMIS/CMIP in a TCP/IP network, and will continue with responsibility for addressing the longer-term requirements.

The output of the MIB working group is to be provided to both the SNMP working group and the NETMAN group, so as to ensure compatibility of monitored items for both network management frameworks.

The MIB working group has produced this memo and a companion. The

companion memo [4] defines a Structure for Management Information (SMI) for use by the managed objects contained in the MIB. This memo defines the list of managed objects.

The IAB also urged the working groups to be "extremely sensitive to the need to keep SNMP simple," and recommends that the MIB working group take as its starting inputs the MIB definitions found in the High-Level Entity Management Systems (HEMS) RFC 1024 [5], the initial SNMP specification [6], and the CMIS/CMIP memos [7,8].

Thus, the list of managed objects defined here, has been derived by taking only those elements which are considered essential. Since such elements are essential, there is no need to allow the implementation of individual objects, to be optional. Rather, all compliant implementations will contain all applicable (see below) objects defined in this memo.

This approach of taking only the essential objects is NOT restrictive, since the SMI defined in the companion memo provides three extensibility mechanisms: one, the addition of new standard objects through the definitions of new versions of the MIB; two, the addition of widely-available but non-standard objects through the multilateral subtree; and three, the addition of private objects through the enterprises subtree. Such additional objects can not only be used for vendor-specific elements, but also for experimentation as required to further the knowledge of which other objects are essential.

The primary criterion for being considered essential was for an object to be contained in all of the above referenced MIB definitions. A few other objects have been included, but only if the MIB working group believed they are truly essential. The detailed list of criteria against which potential inclusions in this (initial) MIB were considered, was:

1) An object needed to be essential for either fault or configuration management.

2) Only weak control objects were permitted (by weak, it is meant that tampering with them can do only limited damage). This criterion reflects the fact that the current management protocols are not sufficiently secure to do more powerful control operations.

3) Evidence of current use and utility was required.

4) An attempt was made to limit the number of objects to about 100 to make it easier for vendors to fully

instrument their software.

5) To avoid redundant variables, it was required that no object be included that can be derived from others in the MIB.

6) Implementation specific objects (e.g., for BSD UNIX) were excluded.

7) It was agreed to avoid heavily instrumenting critical sections of code. The general guideline was one counter per critical section per layer.

4. Objects

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using Abstract Syntax Notation One (ASN.1) [9].

The mechanisms used for describing these objects are specified in the companion memo. In particular, each object has a name, a syntax, and an encoding. The name is an object identifier, an administratively assigned name, which specifies an object type. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the OBJECT DESCRIPTOR, to also refer to the object type.

The syntax of an object type defines the abstract data structure corresponding to that object type. The ASN.1 language is used for this purpose. However, the companion memo purposely restricts the ASN.1 constructs which may be used. These restrictions are explicitly made for simplicity.

The encoding of an object type is simply how that object type is represented using the object type's syntax. Implicitly tied to the notion of an object type's syntax and encoding is how the object type is represented when being transmitted on the network. This memo specifies the use of the basic encoding rules of ASN.1 [10].

4.1. Object Groups

Since this list of managed objects contains only the essential elements, there is no need to allow individual objects to be optional. Rather, the objects are arranged into the following groups:

- System
- Interfaces
- Address Translation
- IP
- ICMP
- TCP
- UDP
- EGP

There are two reasons for defining these groups: one, to provide a means of assigning object identifiers; two, to provide a method for implementations of managed agents to know which objects they must implement. This method is as follows: if the semantics of a group is applicable to an implementation, then it must implement all objects

in that group. For example, an implementation must implement the EGP group if and only if it implements the EGP protocol.

4.2. Format of Definitions

The next section contains the specification of all object types contained in the MIB. Following the conventions of the companion memo, the object types are defined using the following fields:

OBJECT:

A textual name, termed the OBJECT DESCRIPTOR, for the object type, along with its corresponding OBJECT IDENTIFIER.

Syntax:
The abstract syntax for the object type, presented using ASN.1. This must resolve to an instance of the ASN.1 type ObjectSyntax defined in the SMI.

Definition:
A textual description of the semantics of the object type. Implementations should ensure that their interpretation of the object type fulfills this definition since this MIB is intended for use in multi-vendor environments. As such it is vital that object types have consistent meaning across all machines.

Access:
One of read-only, read-write, write-only, or not-accessible.

Status:
One of mandatory, optional, or obsolete.

5. Object Definitions

```
        RFC1066-MIB { iso org(3) dod(6) internet(1) mgmt(2) 1 }

        DEFINITIONS ::= BEGIN

        IMPORTS
                mgmt, OBJECT-TYPE, NetworkAddress, IpAddress,
                Counter, Gauge, TimeTicks
                    FROM RFC1065-SMI;

        mib         OBJECT IDENTIFIER ::= { mgmt 1 }

        system      OBJECT IDENTIFIER ::= { mib 1 }
        interfaces  OBJECT IDENTIFIER ::= { mib 2 }
        at          OBJECT IDENTIFIER ::= { mib 3 }
        ip          OBJECT IDENTIFIER ::= { mib 4 }
        icmp        OBJECT IDENTIFIER ::= { mib 5 }
        tcp         OBJECT IDENTIFIER ::= { mib 6 }
        udp         OBJECT IDENTIFIER ::= { mib 7 }
        egp         OBJECT IDENTIFIER ::= { mib 8 }

        END
```

5.1. The System Group

Implementation of the System group is mandatory for all systems.

OBJECT:
----
sysDescr { system 1 }

Syntax:
OCTET STRING

Definition:
A textual description of the entity. This value should include the full name and version identification of the system's hardware type, software operating-system, and networking software. It is mandatory that this only contain printable ASCII characters.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
sysObjectID { system 2 }

Syntax:
OBJECT IDENTIFIER

Definition:
The vendor's authoritative identification of the network management subsystem contained in the entity. This value is allocated within the SMI enterprises subtree (1.3.6.1.4.1) and provides an easy and unambiguous means for determining "what kind of box" is being managed. For example, if vendor "Flintstones, Inc." was assigned the subtree 1.3.6.1.4.1.42, it could assign the identifier 1.3.6.1.4.1.42.1.1 to its "Fred Router".

Access:
read-only.

Status:
mandatory.

OBJECT:
----

sysUpTime { system 3 }

Syntax:

TimeTicks

Definition:

The time (in hundredths of a second) since the network management portion of the system was last re-initialized.

Access:

read-only.

Status:

mandatory.

5.2. The Interfaces Group

Implementation of the Interfaces group is mandatory for all systems.

OBJECT:
----
ifNumber { interfaces 1 }

Syntax:
INTEGER

Definition:
The number of network interfaces (regardless of their current state) on which this system can send/receive IP datagrams.

Access:
read-only.

Status:
mandatory.

5.2.1. The Interfaces Table

OBJECT:
----
ifTable { interfaces 2 }

Syntax:
SEQUENCE OF IfEntry

Definition:
A list of interface entries. The number of entries is given by the value of ifNumber.

Access:
read-write.

Status:
mandatory.

OBJECT:
----
ifEntry { ifTable 1 }

Syntax:
IfEntry ::= SEQUENCE {

```
            ifIndex
                INTEGER,
            ifDescr
                OCTET STRING,
            ifType
                INTEGER,
            ifMtu
                INTEGER,
            ifSpeed
                Gauge,
            ifPhysAddress
                OCTET STRING,
            ifAdminStatus
                INTEGER,
            ifOperStatus
                INTEGER,
            ifLastChange
                TimeTicks,
            ifInOctets
                Counter,
            ifInUcastPkts
                Counter,
            ifInNUcastPkts
                Counter,
            ifInDiscards
                Counter,
            ifInErrors
                Counter,
            ifInUnknownProtos
                Counter,
            ifOutOctets
                Counter,
            ifOutUcastPkts
                Counter,
            ifOutNUcastPkts
                Counter,
            ifOutDiscards
                Counter,
            ifOutErrors
                Counter,
            ifOutQLen
                Gauge
        }
```

Definition:

An interface entry containing objects at the subnetwork layer and below for a particular interface.

Access:
read-write.

Status:
mandatory.

We now consider the individual components of each interface entry:

OBJECT:
---
ifIndex { ifEntry 1 }

Syntax:
INTEGER

Definition:
A unique value for each interface. Its value ranges between 1 and the value of ifNumber. The value for each interface must remain constant at least from one re-initialization of the entity's network management system to the next re-initialization.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ifDescr { ifEntry 2 }

Syntax:
OCTET STRING

Definition:
A text string containing information about the interface. This string should include the name of the manufacturer, the product name and the version of the hardware interface. The string is intended for presentation to a human; it must not contain anything but printable ASCII characters.

```
Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     ifType { ifEntry 3 }

Syntax:
     INTEGER {
          other(1),          -- none of the following
          regular1822(2),
          hdh1822(3),
          ddn-x25(4),
          rfc877-x25(5),
          ethernet-csmacd(6),
          iso88023-csmacd(7),
          iso88024-tokenBus(8),
          iso88025-tokenRing(9),
          iso88026-man(10),
          starLan(11),
          proteon-10MBit(12),
          proteon-80MBit(13),
          hyperchannel(14),
          fddi(15),
          lapb(16),
          sdlc(17),
          t1-carrier(18),
          cept(19),          -- european equivalent of T-1
          basicIsdn(20),
          primaryIsdn(21),
                             -- proprietary serial
          propPointToPointSerial(22)
     }

Definition:
     The type of interface, distinguished according to the
     physical/link/network protocol(s) immediately "below" IP
     in the protocol stack.

Access:
     read-only.

Status:
     mandatory.
```

OBJECT:
----
ifMtu { ifEntry 4 }

Syntax:
INTEGER

Definition:
The size of the largest IP datagram which can be sent/received on the interface, specified in octets.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifSpeed { ifEntry 5 }

Syntax:
Gauge

Definition:
An estimate of the interface's current bandwidth in bits per second. For interfaces which do not vary in bandwidth or for those where no accurate estimation can be made, this object should contain the nominal bandwidth.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifPhysAddress { ifEntry 6 }

Syntax:
OCTET STRING

Definition:
The interface's address at the protocol layer immediately

"below" IP in the protocol stack. For interfaces which do not have such an address (e.g., a serial line), this object should contain an octet string of zero length.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifAdminStatus { ifEntry 7 }

Syntax:
```
INTEGER {
      up(1),          -- ready to pass packets
      down(2),
      testing(3)      -- in some test mode
    }
```

Definition:
The desired state of the interface. The testing(3) state indicates that no operational packets can be passed.

Access:
read-write.

Status:
mandatory.

OBJECT:
----
ifOperStatus { ifEntry 8 }

Syntax:
```
INTEGER {
      up(1),          -- ready to pass packets
      down(2),
      testing(3)      -- in some test mode
    }
```

Definition:
The current operational state of the interface. The testing(3) state indicates that no operational packets can be passed.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ifLastChange { ifEntry 9 }

Syntax:
TimeTicks

Definition:
The value of sysUpTime at the time the interface entered its current operational state. If the current state was entered prior to the last re-initialization of the local network management subsystem, then this object contains a zero value.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ifInOctets { ifEntry 10 }

Syntax:
Counter

Definition:
The total number of octets received on the interface, including framing characters.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifInUcastPkts { ifEntry 11 }

Syntax:
Counter

Definition:
The number of (subnet) unicast packets delivered to a higher-layer protocol.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifInNUcastPkts { ifEntry 12 }

Syntax:
Counter

Definition:
The number of non-unicast (i.e., subnet broadcast or subnet multicast) packets delivered to a higher-layer protocol.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifInDiscards { ifEntry 13 }

Syntax:
Counter

Definition:
The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer

protocol. One possible reason for discarding such a packet could be to free up buffer space.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ifInErrors { ifEntry 14 }

Syntax:
Counter

Definition:
The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ifInUnknownProtos { ifEntry 15 }

Syntax:
Counter

Definition:
The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifOutOctets { ifEntry 16 }

Syntax:
Counter

Definition:
The total number of octets transmitted out of the interface, including framing characters.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifOutUcastPkts { ifEntry 17 }

Syntax:
Counter

Definition:
The total number of packets that higher-level protocols requested be transmitted to a subnet-unicast address, including those that were discarded or not sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ifOutNUcastPkts { ifEntry 18 }

Syntax:
Counter

Definition:
The total number of packets that higher-level protocols requested be transmitted to a non-unicast (i.e., a subnet broadcast or subnet multicast) address, including those

that were discarded or not sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ifOutDiscards { ifEntry 19 }

Syntax:
Counter

Definition:
The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ifOutErrors { ifEntry 20 }

Syntax:
Counter

Definition:
The number of outbound packets that could not be transmitted because of errors.

Access:
read-only.

Status:
mandatory.

OBJECT:
----

ifOutQLen { ifEntry 21 }

Syntax:
Gauge

Definition:
The length of the output packet queue (in packets).

Access:
read-only.

Status:
mandatory.

5.3. The Address Translation Group

Implementation of the Address Translation group is mandatory for all systems.

The Address Translation group contains one table which is the union across all interfaces of the translation tables for converting a NetworkAddress (e.g., an IP address) into a subnetwork-specific address. For lack of a better term, this document refers to such a subnetwork-specific address as a "physical" address.

Examples of such translation tables are: for broadcast media where ARP is in use, the translation table is equivalent to the ARP cache; or, on an X.25 network where non-algorithmic translation to X.121 addresses is required, the translation table contains the NetworkAddress to X.121 address equivalences.

OBJECT:
---
atTable { at 1 }

Syntax:
SEQUENCE OF AtEntry

Definition:
The Address Translation tables contain the NetworkAddress to "physical" address equivalences. Some interfaces do not use translation tables for determining address equivalences (e.g., DDN-X.25 has an algorithmic method); if all interfaces are of this type, then the Address Translation table is empty, i.e., has zero entries.

Access:
read-write.

Status:
mandatory.

OBJECT:
---
atEntry { atTable 1 }

Syntax:
AtEntry ::= SEQUENCE {
atIfIndex

```
            INTEGER,
        atPhysAddress
            OCTET STRING,
        atNetAddress
            NetworkAddress
    }
```

Definition:
    Each entry contains one NetworkAddress to "physical" address equivalence.

Access:
    read-write.

Status:
    mandatory.

We now consider the individual components of each Address Translation table entry:

OBJECT:
---
    atIfIndex { atEntry 1 }

Syntax:
    INTEGER

Definition:
    The interface on which this entry's equivalence is effective. The interface identified by a particular value of this index is the same interface as identified by the same value of ifIndex.

Access:
    read-write.

Status:
    mandatory.

OBJECT:
---
    atPhysAddress { atEntry 2 }

Syntax:
    OCTET STRING

```
Definition:
     The media-dependent "physical" address.

Access:
     read-write.

Status:
     mandatory.


OBJECT:
-------
     atNetAddress { atEntry 3 }

Syntax:
     NetworkAddress

Definition:
     The NetworkAddress (e.g., the IP address) corresponding to
     the media-dependent "physical" address.

Access:
     read-write.

Status:
     mandatory.
```

5.4. The IP Group

Implementation of the IP group is mandatory for all systems.

```
OBJECT:
-------
     ipForwarding { ip 1 }

Syntax:
     INTEGER {
          gateway(1),    -- entity forwards datagrams
          host(2)        -- entity does NOT forward datagrams
     }

Definition:
     The indication of whether this entity is acting as an IP
     gateway in respect to the forwarding of datagrams
     received by, but not addressed to, this entity.  IP
     gateways forward datagrams; Hosts do not (except those
     Source-Routed via the host).

Access:
     read-only.

Status:
     mandatory.
```

```
OBJECT:
-------
     ipDefaultTTL { ip 2 }

Syntax:
     INTEGER

Definition:
     The default value inserted into the Time-To-Live field of
     the IP header of datagrams originated at this entity,
     whenever a TTL value is not supplied by the transport
     layer protocol.

Access:
     read-write.

Status:
     mandatory.
```

OBJECT:
----
ipInReceives { ip 3 }

Syntax:
Counter

Definition:
The total number of input datagrams received from interfaces, including those received in error.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipInHdrErrors { ip 4 }

Syntax:
Counter

Definition:
The number of input datagrams discarded due to errors in their IP headers, including bad checksums, version number mismatch, other format errors, time-to-live exceeded, errors discovered in processing their IP options, etc.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipInAddrErrors { ip 5 }

Syntax:
Counter

Definition:
The number of input datagrams discarded because the IP address in their IP header's destination field was not a

valid address to be received at this entity. This count includes invalid addresses (e.g., 0.0.0.0) and addresses of unsupported Classes (e.g., Class E). For entities which are not IP Gateways and therefore do not forward datagrams, this counter includes datagrams discarded because the destination address was not a local address.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipForwDatagrams { ip 6 }

Syntax:
Counter

Definition:
The number of input datagrams for which this entity was not their final IP destination, as a result of which an attempt was made to find a route to forward them to that final destination. In entities which do not act as IP Gateways, this counter will include only those packets which were Source-Routed via this entity, and the Source-Route option processing was successful.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipInUnknownProtos { ip 7 }

Syntax:
Counter

Definition:
The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipInDiscards { ip 8 }

Syntax:
Counter

Definition:
The number of input IP datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g. for lack of buffer space). Note that this counter does not include any datagrams discarded while awaiting re-assembly.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipInDelivers { ip 9 }

Syntax:
Counter

Definition:
The total number of input datagrams successfully delivered to IP user-protocols (including ICMP).

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipOutRequests { ip 10 }

Syntax:
Counter

Definition:
The total number of IP datagrams which local IP user-protocols (including ICMP) supplied to IP in requests for transmission. Note that this counter does not include any datagrams counted in ipForwDatagrams.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipOutDiscards { ip 11 }

Syntax:
Counter

Definition:
The number of output IP datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). Note that this counter would include datagrams counted in ipForwDatagrams if any such packets met this (discretionary) discard criterion.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipOutNoRoutes { ip 12 }

Syntax:
Counter

Definition:
The number of IP datagrams discarded because no route could be found to transmit them to their destination. Note that this counter includes any packets counted in ipForwDatagrams which meet this "no-route" criterion.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipReasmTimeout { ip 13 }

Syntax:
INTEGER

Definition:
The maximum number of seconds which received fragments are held while they are awaiting reassembly at this entity.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipReasmReqds { ip 14 }

Syntax:
Counter

Definition:
The number of IP fragments received which needed to be reassembled at this entity.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipReasmOKs { ip 15 }

Syntax:
Counter

Definition:
The number of IP datagrams successfully re-assembled.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipReasmFails { ip 16 }

Syntax:
Counter

Definition:
The number of failures detected by the IP re-assembly algorithm (for whatever reason: timed out, errors, etc).

Note that this is not necessarily a count of discarded IP fragments since some algorithms (notably RFC 815's) can lose track of the number of fragments by combining them as they are received.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipFragOKs { ip 17 }

Syntax:
Counter

Definition:
The number of IP datagrams that have been successfully fragmented at this entity.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipFragFails { ip 18 }

Syntax:
Counter

Definition:
The number of IP datagrams that have been discarded because they needed to be fragmented at this entity but could not be, e.g., because their "Don't Fragment" flag was set.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
ipFragCreates { ip 19 }

Syntax:
Counter

Definition:
The number of IP datagram fragments that have been generated as a result of fragmentation at this entity.

Access:
read-only.

Status:
mandatory.

5.4.1. The IP Address Table

The Ip Address table contains this entity's IP addressing information.

```
OBJECT:
-------
     ipAddrTable { ip 20 }

Syntax:
     SEQUENCE OF IpAddrEntry

Definition:
     The table of addressing information relevant to this
     entity's IP addresses.

Access:
     read-only.

Status:
     mandatory.

OBJECT:
-------
     ipAddrEntry { ipAddrTable 1 }

Syntax:
     IpAddrEntry ::= SEQUENCE {
          ipAdEntAddr
              IpAddress,
          ipAdEntIfIndex
              INTEGER,
          ipAdEntNetMask
              IpAddress,
          ipAdEntBcastAddr
              INTEGER
     }

Definition:
     The addressing information for one of this entity's IP
     addresses.

Access:
     read-only.
```

```
Status:
     mandatory.


OBJECT:
-------
     ipAdEntAddr  { ipAddrEntry 1 }

Syntax:
     IpAddress

Definition:
     The IP address to which this entry's addressing
     information pertains.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     ipAdEntIfIndex  { ipAddrEntry 2 }

Syntax:
     INTEGER

Definition:
     The index value which uniquely identifies the interface
     to which this entry is applicable.  The interface
     identified by a particular value of this index is the
      same interface as identified by the same value of
      ifIndex.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     ipAdEntNetMask  { ipAddrEntry 3 }
```

Syntax:
IpAddress

Definition:
The subnet mask associated with the IP address of this entry. The value of the mask is an IP address with all the network bits set to 1 and all the hosts bits set to 0.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
ipAdEntBcastAddr { ipAddrEntry 4 }

Syntax:
INTEGER

Definition:
The value of the least-significant bit in the IP broadcast address used for sending datagrams on the (logical) interface associated with the IP address of this entry. For example, when the Internet standard all-ones broadcast address is used, the value will be 1.

Access:
read-only.

Status:
mandatory.

5.4.2. The IP Routing Table

The IP Routing Table contains an entry for each route presently known to this entity. Note that the action to be taken in response to a request to read a non-existent entry, is specific to the network management protocol being used.

OBJECT:
----
ipRoutingTable { ip 21 }

```
Syntax:
     SEQUENCE OF IpRouteEntry

Definition:
     This entity's IP Routing table.

Access:
     read-write.

Status:
     mandatory.


OBJECT:
-------
     ipRouteEntry { ipRoutingTable 1 }

Syntax:
     IpRouteEntry ::= SEQUENCE {
          ipRouteDest
              IpAddress,
          ipRouteIfIndex
              INTEGER,
          ipRouteMetric1
              INTEGER,
          ipRouteMetric2
              INTEGER,
          ipRouteMetric3
              INTEGER,
          ipRouteMetric4
              INTEGER,
          ipRouteNextHop
              IpAddress,
          ipRouteType
              INTEGER,
          ipRouteProto
              INTEGER,
          ipRouteAge
              INTEGER
     }

Definition:
     A route to a particular destination.

Access:
     read-write.
```

Status:
mandatory.

We now consider the individual components of each route in the IP Routing Table:

OBJECT:
----
ipRouteDest { ipRouteEntry 1 }

Syntax:
IpAddress

Definition:
The destination IP address of this route. An entry with a value of 0.0.0.0 is considered a default route. Multiple such default routes can appear in the table, but access to such multiple entries is dependent on the table-access mechanisms defined by the network management protocol in use.

Access:
read-write.

Status:
mandatory.

OBJECT:
----
ipRouteIfIndex { ipRouteEntry 2 }

Syntax:
INTEGER

Definition:
The index value which uniquely identifies the local interface through which the next hop of this route should be reached. The interface identified by a particular value of this index is the same interface as identified by the same value of ifIndex.

Access:
read-write.

Status:
mandatory.

OBJECT:
----

ipRouteMetric1 { ipRouteEntry 3 }

Syntax:
INTEGER

Definition:
The primary routing metric for this route. The semantics of this metric are determined by the routing-protocol specified in the route's ipRouteProto value. If this metric is not used, its value should be set to -1.

Access:
read-write.

Status:
mandatory.

OBJECT:
----

ipRouteMetric2 { ipRouteEntry 4 }

Syntax:
INTEGER

Definition:
An alternate routing metric for this route. The semantics of this metric are determined by the routing-protocol specified in the route's ipRouteProto value. If this metric is not used, its value should be set to -1.

Access:
read-write.

Status:
mandatory.

OBJECT:
----

ipRouteMetric3 { ipRouteEntry 5 }

Syntax:
INTEGER

Definition:
An alternate routing metric for this route. The semantics of this metric are determined by the routing-protocol specified in the route's ipRouteProto value. If this metric is not used, its value should be set to -1.

Access:
read-write.

Status:
mandatory.

OBJECT:
---
ipRouteMetric4 { ipRouteEntry 6 }

Syntax:
INTEGER

Definition:
An alternate routing metric for this route. The semantics of this metric are determined by the routing-protocol specified in the route's ipRouteProto value. If this metric is not used, its value should be set to -1.

Access:
read-write.

Status:
mandatory.

OBJECT:
---
ipRouteNextHop { ipRouteEntry 7 }

Syntax:
IpAddress

Definition:
The IP address of the next hop of this route.

Access:
read-write.

Status:
mandatory.

```
OBJECT:
-------
     ipRouteType { ipRouteEntry 8 }

Syntax:
     INTEGER {
          other(1),          -- none of the following

          invalid(2),        -- an invalidated route

                             -- route to directly
          direct(3),         -- connected (sub-)network

                             -- route to a non-local
          remote(4),         -- host/network/sub-network
     }

Definition:
     The type of route.

Access:
     read-write.

Status:
     mandatory.


OBJECT:
-------
     ipRouteProto { ipRouteEntry 9 }

Syntax:
     INTEGER {
          other(1),          -- none of the following

                             -- non-protocol information,
                             -- e.g., manually configured
          local(2),          -- entries

                             -- set via a network management
          netmgmt(3),        -- protocol

                             -- obtained via ICMP,
          icmp(4),           -- e.g., Redirect

                             -- the remaining values are
                             -- all gateway routing protocols
          egp(5),
```

```
            ggp(6),
            hello(7),
            rip(8),
            is-is(9),
            es-is(10),
            ciscoIgrp(11),
            bbnSpfIgp(12),
            oigp(13)
        }
```

Definition:
    The routing mechanism via which this route was learned. Inclusion of values for gateway routing protocols is not intended to imply that hosts should support those protocols.

Access:
    read-only.

Status:
    mandatory.

OBJECT:
---
    ipRouteAge { ipRouteEntry 10 }

Syntax:
    INTEGER

Definition:
    The number of seconds since this route was last updated or otherwise determined to be correct. Note that no semantics of "too old" can be implied except through knowledge of the routing protocol by which the route was learned.

Access:
    read-write.

Status:
    mandatory.

5.5. The ICMP Group

Implementation of the ICMP group is mandatory for all systems.

The ICMP group contains the ICMP input and output statistics.

Note that individual counters for ICMP message (sub-)codes have been omitted from this (version of the) MIB for simplicity.

OBJECT:
----
icmpInMsgs { icmp 1 }

Syntax:
Counter

Definition:
The total number of ICMP messages which the entity received. Note that this counter includes all those counted by icmpInErrors.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpInErrors { icmp 2 }

Syntax:
Counter

Definition:
The number of ICMP messages which the entity received but determined as having errors (bad ICMP checksums, bad length, etc.).

Access:
read-only.

Status:
mandatory.

```
OBJECT:
-------
    icmpInDestUnreachs { icmp 3 }

Syntax:
    Counter

Definition:
     The number of ICMP Destination Unreachable messages
     received.

Access:
     read-only.

Status:
     mandatory.

OBJECT:
-------
     icmpInTimeExcds { icmp 4 }

Syntax:
     Counter

Definition:
     The number of ICMP Time Exceeded messages received.

Access:
     read-only.

Status:
     mandatory.

OBJECT:
-------
     icmpInParmProbs { icmp 5 }

Syntax:
     Counter

Definition:
     The number of ICMP Parameter Problem messages received.

Access:
     read-only.
```

Status:
mandatory.

OBJECT:
----
icmpInSrcQuenchs { icmp 6 }

Syntax:
Counter

Definition:
The number of ICMP Source Quench messages received.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpInRedirects { icmp 7 }

Syntax:
Counter

Definition:
The number of ICMP Redirect messages received.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpInEchos { icmp 8 }

Syntax:
Counter

Definition:
The number of ICMP Echo (request) messages received.

```
Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     icmpInEchoReps { icmp 9 }

Syntax:
     Counter

Definition:
     The number of ICMP Echo Reply messages received.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     icmpInTimestamps { icmp 10 }

Syntax:
     Counter

Definition:
     The number of ICMP Timestamp (request) messages received.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     icmpInTimestampReps { icmp 11 }

Syntax:
     Counter
```

Definition:
The number of ICMP Timestamp Reply messages received.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpInAddrMasks { icmp 12 }

Syntax:
Counter

Definition:
The number of ICMP Address Mask Request messages received.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpInAddrMaskReps { icmp 13 }

Syntax:
Counter

Definition:
The number of ICMP Address Mask Reply messages received.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpOutMsgs { icmp 14 }

Syntax:
Counter

Definition:
The total number of ICMP messages which this entity attempted to send. Note that this counter includes all those counted by icmpOutErrors.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
icmpOutErrors { icmp 15 }

Syntax:
Counter

Definition:
The number of ICMP messages which this entity did not send due to problems discovered within ICMP such as a lack of buffers. This value should not include errors discovered outside the ICMP layer such as the inability of IP to route the resultant datagram. In some implementations there may be no types of error which contribute to this counter's value.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
icmpOutDestUnreachs { icmp 16 }

Syntax:
Counter

Definition:
The number of ICMP Destination Unreachable messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpOutTimeExcds { icmp 17 }

Syntax:
Counter

Definition:
The number of ICMP Time Exceeded messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpOutParmProbs { icmp 18 }

Syntax:
Counter

Definition:
The number of ICMP Parameter Problem messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpOutSrcQuenchs { icmp 19 }

Syntax:
Counter

Definition:
The number of ICMP Source Quench messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
icmpOutRedirects { icmp 20 }

Syntax:
Counter

Definition:
The number of ICMP Redirect messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
icmpOutEchos { icmp 21 }

Syntax:
Counter

Definition:
The number of ICMP Echo (request) messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
icmpOutEchoReps { icmp 22 }

Syntax:
Counter

Definition:
The number of ICMP Echo Reply messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
icmpOutTimestamps { icmp 23 }

Syntax:
Counter

Definition:
The number of ICMP Timestamp (request) messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
icmpOutTimestampReps { icmp 24 }

Syntax:
Counter

Definition:
The number of ICMP Timestamp Reply messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpOutAddrMasks { icmp 25 }

Syntax:
Counter

Definition:
The number of ICMP Address Mask Request messages sent.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
icmpOutAddrMaskReps { icmp 26 }

Syntax:
Counter

Definition:
The number of ICMP Address Mask Reply messages sent.

Access:
read-only.

Status:
mandatory.

5.6. The TCP Group

Implementation of the TCP group is mandatory for all systems that implement the TCP protocol.

Note that instances of object types that represent information about a particular TCP connection are transient; they persist only as long as the connection in question.

```
OBJECT:
-------
     tcpRtoAlgorithm { tcp 1 }

Syntax:
     INTEGER {
          other(1),     -- none of the following
          constant(2),  -- a constant rto
          rsre(3),      -- MIL-STD-1778, Appendix B
          vanj(4)       -- Van Jacobson's algorithm [11]
     }

Definition:
     The algorithm used to determine the timeout value used
     for retransmitting unacknowledged octets.

Access:
     read-only.

Status:
     mandatory.

OBJECT:
-------
     tcpRtoMin { tcp 2 }

Syntax:
     INTEGER

Definition:
     The minimum value permitted by a TCP implementation
     for the retransmission timeout, measured in
     milliseconds.  More refined semantics for objects
     of this type depend upon the algorithm used to
     determine the retransmission timeout.  In particular,
     when the timeout algorithm is rsre(3), an object
     of this type has the semantics of the LBOUND
     quantity described in RFC 793.
```

Access:
read-only.

Status:
mandatory.

OBJECT:
---
tcpRtoMax { tcp 3 }

Syntax:
INTEGER

Definition:
The maximum value permitted by a TCP implementation for the retransmission timeout, measured in milliseconds. More refined semantics for objects of this type depend upon the algorithm used to determine the retransmission timeout. In particular, when the timeout algorithm is rsre(3), an object of this type has the semantics of the UBOUND quantity described in RFC 793.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
tcpMaxConn { tcp 4 }

Syntax:
INTEGER

Definition:
The limit on the total number of TCP connections the entity can support. In entities where the maximum number of connections is dynamic, this object should contain the value "-1".

Access:
read-only.

```
Status:
     mandatory.

OBJECT:
-------
     tcpActiveOpens { tcp 5 }

Syntax:
     Counter

Definition:
     The number of times TCP connections have made a direct
     transition to the SYN-SENT state from the CLOSED
     state.

Access:
     read-only.

Status:
     mandatory.

OBJECT:
-------
     tcpPassiveOpens { tcp 6 }

Syntax:
     Counter

Definition:
     The number of times TCP connections have made a direct
     transition to the SYN-RCVD state from the LISTEN
     state.

Access:
     read-only.

Status:
     mandatory.

OBJECT:
-------
     tcpAttemptFails { tcp 7 }

Syntax:
     Counter
```

Definition:
The number of times TCP connections have made a direct transition to the CLOSED state from either the SYN-SENT state or the SYN-RCVD state, plus the number of times TCP connections have made a direct transition to the LISTEN state from the SYN-RCVD state.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
tcpEstabResets { tcp 8 }

Syntax:
Counter

Definition:
The number of times TCP connections have made a direct transition to the CLOSED state from either the ESTABLISHED state or the CLOSE-WAIT state.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
tcpCurrEstab { tcp 9 }

Syntax:
Gauge

Definition:
The number of TCP connections for which the current state is either ESTABLISHED or CLOSE-WAIT.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
tcpInSegs { tcp 10 }

Syntax:
Counter

Definition:
The total number of segments received, including those received in error. This count includes segments received on currently established connections.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
tcpOutSegs { tcp 11 }

Syntax:
Counter

Definition:
The total number of segments sent, including those on current connections but excluding those containing only retransmitted octets.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
tcpRetransSegs { tcp 12 }

Syntax:
Counter

Definition:
The total number of segments retransmitted - that is, the number of TCP segments transmitted containing one or more previously transmitted octets.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
tcpConnTable { tcp 13 }

Syntax:
SEQUENCE OF TcpConnEntry

Definition:
A table containing TCP connection-specific information.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
tcpConnEntry { tcpConnTable 1 }

Syntax:

```
TcpConnEntry ::= SEQUENCE {
    tcpConnState
        INTEGER,
    tcpConnLocalAddress
        IpAddress,
    tcpConnLocalPort
        INTEGER (0..65535),
    tcpConnRemAddress
        IpAddress,
    tcpConnRemPort
        INTEGER (0..65535)
}
```

```
Definition:
     Information about a particular current TCP connection.
     An object of this type is transient, in that it ceases
     to exist when (or soon after) the connection makes the
     transition to the CLOSED state.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     tcpConnState { tcpConnEntry 1 }

Syntax:
     INTEGER {
          closed(1),
          listen(2),
          synSent(3),
          synReceived(4),
          established(5),
          finWait1(6),
          finWait2(7),
          closeWait(8),
          lastAck(9),
          closing(10),
          timeWait(11)
     }

Definition:
     The state of this TCP connection.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     tcpConnLocalAddress { tcpConnEntry 2 }

Syntax:
     IpAddress
```

```
Definition:
     The local IP address for this TCP connection.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     tcpConnLocalPort { tcpConnEntry 3 }

Syntax:
     INTEGER (0..65535)

Definition:
     The local port number for this TCP connection.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     tcpConnRemAddress { tcpConnEntry 4 }

Syntax:
     IpAddress

Definition:
     The remote IP address for this TCP connection.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     tcpConnRemPort { tcpConnEntry 5 }
```

Syntax:
INTEGER (0..65535)

Definition:
The remote port number for this TCP connection.

Access:
read-only.

Status:
mandatory.

5.7. The UDP Group

Implementation of the UDP group is mandatory for all systems which implement the UDP protocol.

```
OBJECT:
-------
     udpInDatagrams { udp 1 }

Syntax:
     Counter

Definition:
     The total number of UDP datagrams delivered to UDP
     users.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     udpNoPorts { udp 2 }

Syntax:
     Counter

Definition:
     The total number of received UDP datagrams for which
     there was no application at the destination port.

Access:
     read-only.

Status:
     mandatory.


OBJECT:
-------
     udpInErrors { udp 3 }

Syntax:
     Counter
```

Definition:
The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
udpOutDatagrams { udp 4 }

Syntax:
Counter

Definition:
The total number of UDP datagrams sent from this entity.

Access:
read-only.

Status:
mandatory.

5.8. The EGP Group

Implementation of the EGP group is mandatory for all systems which implement the EGP protocol.

OBJECT:
----
egpInMsgs { egp 1 }

Syntax:
Counter

Definition:
The number of EGP messages received without error.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
egpInErrors { egp 2 }

Syntax:
Counter

Definition:
The number of EGP messages received that proved to be in error.

Access:
read-only.

Status:
mandatory.

OBJECT:
----
egpOutMsgs { egp 3 }

Syntax:
Counter

Definition:
The total number of locally generated EGP messages.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
egpOutErrors { egp 4 }

Syntax:
Counter

Definition:
The number of locally generated EGP messages not sent due to resource limitations within an EGP entity.

Access:
read-only.

Status:
mandatory.

5.8.1. The EGP Neighbor Table

The Egp Neighbor table contains information about this entity's EGP neighbors.

OBJECT:
---
egpNeighTable { egp 5 }

Syntax:
SEQUENCE OF EgpNeighEntry

Definition:
The EGP neighbor table.

Access:
read-only.

Status:
mandatory.

```
OBJECT:
-------
    egpNeighEntry { egpNeighTable 1 }

Syntax:
    EgpNeighEntry ::= SEQUENCE {
        egpNeighState
            INTEGER,
        egpNeighAddr
            IpAddress
    }
```

Definition:
Information about this entity's relationship with a particular EGP neighbor.

Access:
read-only.

Status:
mandatory.

We now consider the individual components of each EGP neighbor entry:

```
OBJECT:
-------
    egpNeighState { egpNeighEntry 1 }

Syntax:
    INTEGER {
        idle(1),
        acquisition(2),
        down(3),
        up(4),
        cease(5)
    }
```

Definition:
The EGP state of the local system with respect to this entry's EGP neighbor. Each EGP state is represented by a value that is one greater than the numerical value associated with said state in RFC 904.

Access:
read-only.

Status:
mandatory.

OBJECT:
---
egpNeighAddr { egpNeighEntry 2 }

Syntax:
IpAddress

Definition:
The IP address of this entry's EGP neighbor.

Access:
read-only.

Status:
mandatory.

6. Definitions

```
RFC1066-MIB { iso org(3) dod(6) internet(1) mgmt(2) 1 }

DEFINITIONS ::= BEGIN

IMPORTS
        mgmt, OBJECT-TYPE, NetworkAddress, IpAddress,
        Counter, Gauge, TimeTicks
            FROM RFC1065-SMI;

  mib           OBJECT IDENTIFIER ::= { mgmt 1 }

  system        OBJECT IDENTIFIER ::= { mib 1 }
  interfaces    OBJECT IDENTIFIER ::= { mib 2 }
  at            OBJECT IDENTIFIER ::= { mib 3 }
  ip            OBJECT IDENTIFIER ::= { mib 4 }
  icmp          OBJECT IDENTIFIER ::= { mib 5 }
  tcp           OBJECT IDENTIFIER ::= { mib 6 }
  udp           OBJECT IDENTIFIER ::= { mib 7 }
  egp           OBJECT IDENTIFIER ::= { mib 8 }

  -- object types

  -- the System group

  sysDescr OBJECT-TYPE
          SYNTAX  OCTET STRING
          ACCESS  read-only
          STATUS  mandatory
          ::= { system 1 }

  sysObjectID OBJECT-TYPE
          SYNTAX  OBJECT IDENTIFIER
          ACCESS  read-only
          STATUS  mandatory
          ::= { system 2 }

  sysUpTime OBJECT-TYPE
          SYNTAX  TimeTicks
          ACCESS  read-only
          STATUS  mandatory
          ::= { system 3 }

  -- the Interfaces group

  ifNumber OBJECT-TYPE
          SYNTAX  INTEGER
```

```
            ACCESS  read-only
            STATUS  mandatory
            ::= { interfaces 1 }

    -- the Interfaces table

    ifTable OBJECT-TYPE
            SYNTAX  SEQUENCE OF IfEntry
            ACCESS  read-write
            STATUS  mandatory
            ::= { interfaces 2 }

    ifEntry OBJECT-TYPE
            SYNTAX  IfEntry
            ACCESS  read-write
            STATUS  mandatory
            ::= { ifTable 1 }

    IfEntry ::= SEQUENCE {
        ifIndex
            INTEGER,
        ifDescr
            OCTET STRING,
        ifType
            INTEGER,
        ifMtu
            INTEGER,
        ifSpeed
            Gauge,
        ifPhysAddress
            OCTET STRING,
        ifAdminStatus
            INTEGER,
        ifOperStatus
            INTEGER,
        ifLastChange
            TimeTicks,
        ifInOctets
            Counter,
        ifInUcastPkts
            Counter,
        ifInNUcastPkts
            Counter,
        ifInDiscards
            Counter,
        ifInErrors
            Counter,
        ifInUnknownProtos
```

```
            Counter,
        ifOutOctets
            Counter,
        ifOutUcastPkts
            Counter,
        ifOutNUcastPkts
            Counter,
        ifOutDiscards
            Counter,
        ifOutErrors
            Counter,
        ifOutQLen
            Gauge
    }

    ifIndex OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-only
            STATUS  mandatory
            ::= { ifEntry 1 }

    ifDescr OBJECT-TYPE
            SYNTAX  OCTET STRING
            ACCESS  read-only
            STATUS  mandatory
            ::= { ifEntry 2 }

    ifType OBJECT-TYPE
             SYNTAX  INTEGER {
                     other(1),     -- none of the following
                     regular1822(2),
                     hdh1822(3),
                     ddn-x25(4),
                     rfc877-x25(5),
                     ethernet-csmacd(6),
                     iso88023-csmacd(7),
                     iso88024-tokenBus(8),
                     iso88025-tokenRing(9),
                     iso88026-man(10),
                     starLan(11),
                     proteon-10MBit(12),
                     proteon-80MBit(13),
                     hyperchannel(14),
                     fddi(15),
                     lapb(16),
                     sdlc(17),
                     t1-carrier(18),
                     cept(19),
```

```
                basicIsdn(20),
                primaryIsdn(21),
                                -- proprietary serial
                propPointToPointSerial(22)
            }
        ACCESS  read-only
        STATUS  mandatory
        ::= { ifEntry 3 }

ifMtu OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        ::= { ifEntry 4 }

ifSpeed OBJECT-TYPE
        SYNTAX  Gauge
        ACCESS  read-only
        STATUS  mandatory
        ::= { ifEntry 5 }

ifPhysAddress OBJECT-TYPE
        SYNTAX  OCTET STRING
        ACCESS  read-only
        STATUS  mandatory
        ::= { ifEntry 6 }

ifAdminStatus OBJECT-TYPE
        SYNTAX  INTEGER {
                up(1),          -- ready to pass packets
                down(2),
                testing(3)      -- in some test mode
                }
        ACCESS  read-write
        STATUS  mandatory
        ::= { ifEntry 7 }

ifOperStatus OBJECT-TYPE
        SYNTAX  INTEGER {
                up(1),          -- ready to pass packets
                down(2),
                testing(3)      -- in some test mode
                }
        ACCESS  read-only
        STATUS  mandatory
        ::= { ifEntry 8 }

ifLastChange OBJECT-TYPE
```

```
                SYNTAX  TimeTicks
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 9 }

        ifInOctets OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 10 }

        ifInUcastPkts OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::=  { ifEntry 11 }

        ifInNUcastPkts OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 12 }

        ifInDiscards OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 13 }

        ifInErrors OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 14 }

        ifInUnknownProtos OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 15 }

        ifOutOctets OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 16 }

        ifOutUcastPkts OBJECT-TYPE
```

```
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 17 }

        ifOutNUcastPkts OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 18 }

        ifOutDiscards OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 19 }

        ifOutErrors OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 20 }

        ifOutQLen OBJECT-TYPE
                SYNTAX  Gauge
                ACCESS  read-only
                STATUS  mandatory
                ::= { ifEntry 21 }

        -- the Address Translation group

        atTable OBJECT-TYPE
                SYNTAX  SEQUENCE OF AtEntry
                ACCESS  read-write
                STATUS  mandatory
                ::= { at 1 }

        atEntry OBJECT-TYPE
                SYNTAX  AtEntry
                ACCESS  read-write
                STATUS  mandatory
                ::= { atTable 1 }

        AtEntry ::= SEQUENCE {
            atIfIndex
                INTEGER,
            atPhysAddress
                OCTET STRING,
```

```
        atNetAddress
            NetworkAddress
    }

    atIfIndex OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-write
            STATUS  mandatory
            ::= { atEntry 1 }

    atPhysAddress OBJECT-TYPE
            SYNTAX  OCTET STRING
            ACCESS  read-write
            STATUS  mandatory
            ::= { atEntry 2 }

    atNetAddress OBJECT-TYPE
            SYNTAX  NetworkAddress
            ACCESS  read-write
            STATUS  mandatory
            ::= { atEntry 3 }

    -- the IP group

    ipForwarding OBJECT-TYPE
            SYNTAX  INTEGER {
                gateway(1), -- entity forwards datagrams
                host(2)     -- entity does NOT forward datagrams
                }
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 1 }

    ipDefaultTTL OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-write
            STATUS  mandatory
            ::= { ip 2 }

    ipInReceives OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 3 }

    ipInHdrErrors OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
```

```
            STATUS  mandatory
            ::= { ip 4 }

        ipInAddrErrors OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 5 }

        ipForwDatagrams OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 6 }

        ipInUnknownProtos OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 7 }

        ipInDiscards OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 8 }

        ipInDelivers OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 9 }

        ipOutRequests OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 10 }

        ipOutDiscards OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 11 }

        ipOutNoRoutes OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
```

```
                STATUS  mandatory
                ::= { ip 12 }

        ipReasmTimeout OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-only
                STATUS  mandatory
                ::= { ip 13 }

        ipReasmReqds OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ip 14 }

        ipReasmOKs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ip 15 }

        ipReasmFails OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ip 16 }

        ipFragOKs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ip 17 }

        ipFragFails OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ip 18 }

        ipFragCreates OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { ip 19 }

        -- the IP Interface table

        ipAddrTable OBJECT-TYPE
```

```
            SYNTAX  SEQUENCE OF IpAddrEntry
            ACCESS  read-only
            STATUS  mandatory
            ::= { ip 20 }

    ipAddrEntry OBJECT-TYPE
            SYNTAX  IpAddrEntry
            ACCESS  read-only
            STATUS  mandatory
            ::= { ipAddrTable 1 }

    IpAddrEntry ::= SEQUENCE {
        ipAdEntAddr
            IpAddress,
        ipAdEntIfIndex
            INTEGER,
        ipAdEntNetMask
            IpAddress,
        ipAdEntBcastAddr
            INTEGER
    }

    ipAdEntAddr OBJECT-TYPE
            SYNTAX  IpAddress
            ACCESS  read-only
            STATUS  mandatory
            ::=  { ipAddrEntry 1 }

    ipAdEntIfIndex OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-only
            STATUS  mandatory
            ::=  { ipAddrEntry 2 }

    ipAdEntNetMask OBJECT-TYPE
            SYNTAX  IpAddress
            ACCESS  read-only
            STATUS  mandatory
            ::=  { ipAddrEntry 3 }

    ipAdEntBcastAddr OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-only
            STATUS  mandatory
            ::= { ipAddrEntry 4 }

    -- the IP Routing table
```

```
ipRoutingTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF IpRouteEntry
        ACCESS  read-write
        STATUS  mandatory
        ::= { ip 21 }

ipRouteEntry OBJECT-TYPE
        SYNTAX  IpRouteEntry
        ACCESS  read-write
        STATUS  mandatory
        ::= { ipRoutingTable 1 }

IpRouteEntry ::= SEQUENCE {
    ipRouteDest
        IpAddress,
    ipRouteIfIndex
        INTEGER,
    ipRouteMetric1
        INTEGER,
    ipRouteMetric2
        INTEGER,
    ipRouteMetric3
        INTEGER,
    ipRouteMetric4
        INTEGER,
    ipRouteNextHop
        IpAddress,
    ipRouteType
        INTEGER,
    ipRouteProto
        INTEGER,
    ipRouteAge
        INTEGER
}

ipRouteDest OBJECT-TYPE
        SYNTAX  IpAddress
        ACCESS  read-write
        STATUS  mandatory
        ::= { ipRouteEntry 1 }

ipRouteIfIndex  OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-write
        STATUS  mandatory
        ::= { ipRouteEntry 2 }

ipRouteMetric1 OBJECT-TYPE
```

```
            SYNTAX  INTEGER
            ACCESS  read-write
            STATUS  mandatory
            ::= { ipRouteEntry 3 }

        ipRouteMetric2 OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-write
            STATUS  mandatory
            ::= { ipRouteEntry 4 }

        ipRouteMetric3 OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-write
            STATUS  mandatory
            ::= { ipRouteEntry 5 }

        ipRouteMetric4 OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-write
            STATUS  mandatory
            ::= { ipRouteEntry 6 }

        ipRouteNextHop OBJECT-TYPE
            SYNTAX  IpAddress
            ACCESS  read-write
            STATUS  mandatory
            ::= { ipRouteEntry 7 }

        ipRouteType OBJECT-TYPE
            SYNTAX  INTEGER {
              other(1),       -- none of the following

              invalid(2),     -- an invalidated route

                              -- route to directly
              direct(3),      -- connected (sub-)network

                              -- route to a non-local
              remote(4),      -- host/network/sub-network
                }
            ACCESS  read-write
            STATUS  mandatory
            ::= { ipRouteEntry 8 }

        ipRouteProto OBJECT-TYPE
            SYNTAX  INTEGER {
              other(1),     -- none of the following
```

```
                        -- non-protocol information
                        --   e.g., manually
                    local(2),     --   configured entries

                        -- set via a network
                    netmgmt(3),   --   management protocol

                        -- obtained via ICMP,
                    icmp(4),      --   e.g., Redirect

                        -- the following are
                        -- gateway routing protocols
                    egp(5),
                    ggp(6),
                    hello(7),
                    rip(8),
                    is-is(9),
                    es-is(10),
                    ciscoIgrp(11),
                    bbnSpfIgp(12),
                    oigp(13)
                      }
                ACCESS  read-only
                STATUS  mandatory
                ::= { ipRouteEntry 9 }

        ipRouteAge OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-write
                STATUS  mandatory
                ::= { ipRouteEntry 10 }

        -- the ICMP group

        icmpInMsgs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 1 }

        icmpInErrors OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 2 }

        icmpInDestUnreachs OBJECT-TYPE
                SYNTAX  Counter
```

```
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 3 }

        icmpInTimeExcds OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 4 }

        icmpInParmProbs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 5 }

        icmpInSrcQuenchs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 6 }

        icmpInRedirects OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 7 }

        icmpInEchos OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 8 }

        icmpInEchoReps OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 9 }

        icmpInTimestamps OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 10 }

        icmpInTimestampReps OBJECT-TYPE
                SYNTAX  Counter
```

```
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 11 }

        icmpInAddrMasks OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 12 }

        icmpInAddrMaskReps OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 13 }

        icmpOutMsgs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 14 }

        icmpOutErrors OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 15 }

        icmpOutDestUnreachs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 16 }

        icmpOutTimeExcds OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 17 }

        icmpOutParmProbs OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 18 }

        icmpOutSrcQuenchs OBJECT-TYPE
                SYNTAX  Counter
```

```
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 19 }

        icmpOutRedirects OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 20 }

        icmpOutEchos OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 21 }

        icmpOutEchoReps OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 22 }

        icmpOutTimestamps OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 23 }

        icmpOutTimestampReps OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 24 }

        icmpOutAddrMasks OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 25 }

        icmpOutAddrMaskReps OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                ::= { icmp 26 }

        -- the TCP group
```

```
tcpRtoAlgorithm OBJECT-TYPE
        SYNTAX  INTEGER {
        other(1),     -- none of the following
        constant(2), -- a constant rto
        rsre(3),      -- MIL-STD-1778, Appendix B
        vanj(4)       -- Van Jacobson's algorithm [11]
                }
        ACCESS  read-only
        STATUS  mandatory
        ::= { tcp 1 }

tcpRtoMin OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        ::= { tcp 2 }

tcpRtoMax OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        ::= { tcp 3 }

tcpMaxConn OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        ::= { tcp 4 }

tcpActiveOpens OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { tcp 5 }

tcpPassiveOpens OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { tcp 6 }

tcpAttemptFails OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { tcp 7 }

tcpEstabResets OBJECT-TYPE
```

```
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcp 8 }

        tcpCurrEstab OBJECT-TYPE
            SYNTAX  Gauge
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcp 9 }

        tcpInSegs OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcp 10 }

        tcpOutSegs OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcp 11 }

        tcpRetransSegs OBJECT-TYPE
            SYNTAX  Counter
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcp 12 }

        -- the TCP connections table

        tcpConnTable OBJECT-TYPE
            SYNTAX  SEQUENCE OF TcpConnEntry
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcp 13 }

        tcpConnEntry OBJECT-TYPE
            SYNTAX  TcpConnEntry
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcpConnTable 1 }

        TcpConnEntry ::= SEQUENCE {
            tcpConnState
                INTEGER,
            tcpConnLocalAddress
                IpAddress,
```

```
        tcpConnLocalPort
            INTEGER (0..65535),
        tcpConnRemAddress
            IpAddress,
        tcpConnRemPort
            INTEGER (0..65535)
    }

    tcpConnState OBJECT-TYPE
            SYNTAX  INTEGER {
                        closed(1),
                        listen(2),
                        synSent(3),
                        synReceived(4),
                        established(5),
                        finWait1(6),
                        finWait2(7),
                        closeWait(8),
                        lastAck(9),
                        closing(10),
                        timeWait(11)
                    }
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcpConnEntry 1 }

    tcpConnLocalAddress OBJECT-TYPE
            SYNTAX  IpAddress
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcpConnEntry 2 }

    tcpConnLocalPort OBJECT-TYPE
            SYNTAX  INTEGER (0..65535)
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcpConnEntry 3 }

    tcpConnRemAddress OBJECT-TYPE
            SYNTAX  IpAddress
            ACCESS  read-only
            STATUS  mandatory
            ::= { tcpConnEntry 4 }

    tcpConnRemPort OBJECT-TYPE
            SYNTAX  INTEGER (0..65535)
            ACCESS  read-only
            STATUS  mandatory
```

```
        ::= { tcpConnEntry 5 }

-- the UDP group

udpInDatagrams OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { udp 1 }

udpNoPorts OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { udp 2 }

udpInErrors OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { udp 3 }

udpOutDatagrams OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { udp 4 }

-- the EGP group

egpInMsgs OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { egp 1 }

egpInErrors OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { egp 2 }

egpOutMsgs OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { egp 3 }
```

```
egpOutErrors OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        ::= { egp 4 }

-- the EGP Neighbor table

egpNeighTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF EgpNeighEntry
        ACCESS  read-only
        STATUS  mandatory
        ::= { egp 5 }

egpNeighEntry OBJECT-TYPE
        SYNTAX  EgpNeighEntry
        ACCESS  read-only
        STATUS  mandatory
        ::= { egpNeighTable 1 }

EgpNeighEntry ::= SEQUENCE {
    egpNeighState
        INTEGER,
    egpNeighAddr
        IpAddress
}

egpNeighState OBJECT-TYPE
        SYNTAX  INTEGER {
                    idle(1),
                    acquisition(2),
                    down(3),
                    up(4),
                    cease(5)
                }
        ACCESS  read-only
        STATUS  mandatory
        ::= { egpNeighEntry 1 }

egpNeighAddr OBJECT-TYPE
        SYNTAX  IpAddress
        ACCESS  read-only
        STATUS  mandatory
        ::= { egpNeighEntry 2 }

END
```

7. Acknowledgements

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